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ANALYSIS OF DENOMINATE NUMBERS IN TWO SERIES OF ARITHMETIC TEXTBOOKS

Submitted by

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Boston University
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INTRODUCTION

This study reports the analysis of two arithmetic text-book series with respect to the units of weight and measure and more especially the denominate numbers, that is, numbers which refer to units of measure, as, for example, 3 inches, 4 pounds. Miss Vernette B. Moore constructed an analysis of denominate numbers found in four text-books for the purpose of determining the concepts and skills needed in teaching denominate numbers.[1] This study assumed that the elements and processes found in these text-books were proper teaching material. The studies by Wilson with respect to the social usage of arithmetic and the more recent investigations of Louth,[2] Sala,[3] and Traniello,[4] into the uses of weights and measures in business and industry, present evidence which leads us to be critical of the subject matter found in text-books in connection with denominate numbers. The first step in a critical

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1. Moore, Vernette B. An Analysis of Denominate Numbers with Data on Their Teaching. State University of Iowa, 1929.
2. Louth, Mary. Units of Measurement in Industry. B.U. Graduate School thesis, 1931.
3. Sala, V. Denominate Numbers used in the Factories of New Britain. B.U. School of Education thesis, 1931.
4. Traniello, A. Use of Tables of Measurement in Business. B.U. School of Education thesis, 1930.

examination of a text-book in respect to denominate numbers must necessarily be an analysis which shows the content of the text-book.

The present study offers an analysis of each of the following two text-book series:

Strayer-Upton
Strayer-Upton Arithmetics
American Book Company
Three Book Series; 1928 edition

Hoyt and Peet
The New Everyday Arithmetic
Houghton Mifflin Company
Three Book Series; first book, 1930 edition;
second and third book, 1927 edition.

Units of weight and measure have been classified under six main headings, namely,

1. Relations among units of measure.
2. Informational matter with reference to weights and measures.
3. Denominate numbers merely mentioned in written problems and involving no computation with denominate numbers as such.
4. Table facts in examples and written problems.
5. Reduction of denominate numbers.
6. Computation with denominate numbers.

The units of weight and measure assembled under each of these main headings have been further sub-divided into groups according to the usual "table" classification.

In other words, all units of measure dealing with length have been grouped under "Linear Measure"; those dealing with square units of measure, under "Square Measure", and so on.

This analysis does not include tables of weights and measures found in the rear of the text-books. These tables are intended for reference and pupils are not required to memorize them as they are in the case of those tables found in the text proper. All computation with United States money (including changing of money), computation with metric measures, as well as computations by the 100, or by the 1000, have been excluded from the analysis, since they are decimal. Examples and written problems in mensuration have also been excluded, since they properly form a part of intuitive geometry, rather than of denominate numbers. It also appears proper to exclude work in connection with telling time, making schedules for buses, trolley cars and trains, the use of the calendar, drawing to scale, graphs, work in interest, banking, commission, discount, installment buying, stocks, bonds, insurance, equations, taxes, duty, changing Fahrenheit readings to Centigrade readings and visa versa, food problems involving the use of the term calories.

PART ONE

The following analysis covers the units of weight and measure, with special reference to denominate numbers, as found in the three book series of the Strayer-Upton Arithmetics.

RELATIONS AMONG UNITS OF MEASURE

Tables I to XIV which follow show the various tables of measures found in the Strayer-Upton series of arithmetics, each Table representing one table of measure, except that counting articles and counting paper have been grouped together under Table VIII and the metric tables of length, of capacity, and of weight, have been grouped together in Table XII. In each case the equalities found in the table of measure has been stated to the left of the figure and the frequency of occurrence of these equalities is indicated in the upper left corner of each square. All other relations found in the texts of the Strayer-Upton Series are listed to the right and the frequency of occurrence of these equalities, either in written problems or in some other isolated form, is recorded in the lower right of the cell.

TABLE I. RELATIONS AMONG UNITS OF UNITED STATES MONEY FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

10 mills = 1 cent			1 mill = 1/10 cent
5 cents = 1 nickel	1	1	1 nickel = 5 cents
lo cents = 1 dime	1	1	1 dime = 10 cents
25 cents = 1 quarter	1		1 quarter = 25 cents
50 cents = ½ dollar	1		½ dollar = 50 cents
100 cents = 1 dollar	1		1 dollar = 100 cents
10 dimes = 1 dollar	1		1 dollar = 10 dimes
Total	6	2	

TABLE II. RELATIONS AMONG UNITS IN LINEAR MEASURE FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

12 inches = 1 foot	4		1 foot = 12 inches
36 inches = 1 yard	1	1	1 yard = 36 inches
3 feet = 1 yard	3		1 yard = 3 feet
16½ feet = 1 rod	2	1	1 rod = 16½ feet
5280 feet = 1 mile	2	1	1 mile = 5280 feet
5½ yards = 1 rod	2	1	1 rod = 5½ yards
		3	1 mile = 1760 yards
320 rods = 1 mile	2		1 mile = 320 rods
Total	16	7	

TABLE III. RELATIONS AMONG UNITS IN SQUARE MEASURE FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

144 sq.in. = 1 sq.ft.	4	1 sq. ft. = 144 sq.in.
9 sq.ft. = 1 sq.yd.	4	1 sq. yd. = 9 sq. ft.
30¼ sq.yd. = 1 sq.rd.	3	1 sq. rd. = 30¼ sq. yd.
160 sq.rd. = 1 acre	3	1 acre = 160 sq. rd.
43,560 sq.ft. = 1 acre	3	1 acre = 43,560 sq. ft.
640 acres = 1 sq.mi.	3	1 sq. mi. = 640 acres
Total	20	

TABLE IV. RELATIONS AMONG UNITS IN CUBIC MEASURE FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

1728 cu.in. = 1 cu.ft.	3	1 cu. ft. = 1728 cu. in.
27 cu.ft. = 1 cu.yd.	3	1 cu. yd. = 27 cu. ft.
Total	6	

TABLE V. RELATIONS AMONG UNITS IN DRY MEASURE FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

2 pt. = 1 qt.	3	1 qt. = 2 pt.
8 qt. = 1 pk.	3	1 pk. = 8 qt.
4 pk. = 1 bu.	3	1 bu. = 4 pk.
Total.	9	

TABLE VI. RELATIONS AMONG UNITS IN LIQUID MEASURE FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

2 pt. = 1 qt.	3		1 qt. = 2 pt.
4 qt. = 1 gal.	3		1 gal. = 4 qt.
Total	6		

TABLE VII. RELATIONS AMONG UNITS IN MEASURE OF WEIGHT FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

16 oz. = 1 lb.	3	1	1 lb. = 16 oz.
100 lb. = 1 cwt.	2		1 cwt. = 100 lb.
2000 lb. = 1 T.	3		2000 lb. = 1 T.
Total	8	1	

TABLE VIII. RELATIONS AMONG UNITS IN TABLES OF COUNTING FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

12 units = 1 doz.	1	2	1 doz. = 12 units
12 dozen = 1 gross	1		1 gross = 12 dozen
144 units = 1 gross	1		1 gross = 144 units
20 units = 1 score	1		1 score = 20 units
Total	4	2	
24 sheets = 1 quire	1		1 quire = 24 sheets
480 (500) sheets = 1 ream	1		1 ream = 480 (500) sheets
20 quires = 1 ream	1		1 ream = 20 quires
Total	3		

TABLE IX. RELATIONS AMONG UNITS IN MEASURE OF TIME FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

60 seconds = 1 minute	4		1 minute = 60 seconds
60 minutes = 1 hour	4		1 hour = 60 minutes
24 hours = 1 day	5		1 day = 24 hours
7 days = 1 week	4		1 week = 7 days
365 days = 1 year	2	1	1 year = 365 days
366 days = 1 leap year	2		1 leap year = 366 days
4 weeks = 1 month	1		1 month = 4 weeks
52 weeks = 1 year	1	1	1 year = 52 weeks
12 months = 1 year	3		1 year = 12 months
100 years = 1 century	2		1 century = 100 years
Total	28	2	

TABLE X. RELATIONS AMONG UNITS IN MEASURE OF CAPACITY FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

1 gal. = 231 cu.in.	3	1	231 cu. in. = 1 gal.
31½ gal. = 1 bbl.	1	1	1 bbl. = 31½ gal.
7½ gal. = 1 cu.ft.	3		
1 cu. ft. = 7½ gal.	3		
Total	10	2	

TABLE XI. RELATIONS AMONG UNITS IN MEASURE OF CONTENT FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

1 bu. = 2150 cu. in.	3		2150 cu. in. = 1 bu.
8 bu. = 1 cu. ft.	1		
1 bu. = 1¼ cu. ft.	3	1	1¼ cu. ft. = 1 bu.
1 T. hard coal = 35 cu.ft.	4		
1 cu. ft. = 8 bu.	1		
Total	12	1	

TABLE XII. RELATIONS AMONG UNITS OF METRIC MEASURES FOUND IN THE STRAYER-UPTON SERIES.

Equalities to the left are found in tables. Frequency of occurrence of these table facts is noted in upper left of cell.

1 mm. = 1/1000 m.	1
1 cm. = 1/100 m.	1
1 dm. = 1/10 m.	1
1 Dm. = 10 m.	1
1 Hm. = 100 m.	1
1 Km. = 1000 m.	1
Total	6

1 ml. = 1/1000 l.	1
1 Hl. = 100 l.	1
Total	2

1 Kg. = 1000 g.	1
1 M. T. = 1000 Kg.	1
Total	2

TABLE XIII. RELATIONS BETWEEN UNITS OF METRIC MEASURES AND ENGLISH MEASURES FOUND IN STRAYER-UPTON

Equalities to the left are found in tables of measures. Frequency of occurrence of these table facts is noted in upper left of cell. All other equalities found in texts are listed to the right; frequency of occurrence is noted in lower right of cell. Blank indicates no occurrence.

1 m. = 39.37 in.	1		
1 m. = 1.1 yd.	1		
1 Km. = .6 mi.	1		
Total	3		
		1	1 liter = about 1 qt.
Total		1	
		1	1 Kg. = 2.2 pounds
Total		1	

TABLE XIV. RELATIONS IN MISCELLANEOUS MEASURES
FOUND IN THE STRAYER-UPTON SERIES.

This table shows relations in miscellaneous measures and the frequency of their occurrence in the Strayer-Upton Arithmetics.

Money	
1 English pound sterling = $4.8665	1
Linear Measure	
1 knot = 1.15 mi.	1
Capacity and Content	
1 cu.ft. ice = 56.4 lb.	1
1 cu.ft. water = 62.5 lb.	4
1 cu.ft. marble or granite - 168 lb.	2
1 cu.ft. pine = 25 1 lb.	1
1 cu.ft. hard coal = 57 lb.	1
1 bu. potatoes= 60 lb.	1
1 bu. cherries = 50 lb.	1
1 bu. wheat = 60 lb.	1
1 bu. wheat = 60 lb.	1
1 gal. water= 8.3 lb.	1
Weight	
1 lb. sugar = 2 cups	2
1 lb. flour = 4 cups	1
1 pt. milk = 2 cups	1
1 lb. butter = 32 tbsp.	1
1 long ton = 2240 lb.	1
1 ton of hay = 500 cu. ft.	1
Liquid	
1 pt. = 2 glasses	1
1 qt. = 4 glasses	1
1 gal. = 16 glasses	1

INFORMATIONAL MATTER WITH REFERENCE TO UNITS OF MEASURES.

Since actual use of units of weight and measure is always in connection with articles and commodities, an understanding of the meaning and use of units of weight and measure can only come through commodities. As soon as a commodity is thoroughly understood, the appropriate unit of measure to be used in connection with it has been learned incidentally.

Units of weight and measure are not learned as such, but in connection with commodities. It is this idea of the connection or inter-relation between commodities and units of weight and measure that the expression "informational matter", used here in connection with denominate numbers, is meant to convey. No manipulation or computation with denominate numbers is involved, but simply an understanding that a given unit of measure is used in connection with a given commodity.

The instances in which nothing more is involved than an understanding of the meaning of a unit of measure through its use with a commodity, have been gathered and grouped under two headings, namely, those appearing in statement form and those appearing in question form. For instance, the statement is made that "When we want to know how hot or how cold it is, we look at a thermometer and read the number of degrees of temperature."[1] The information is imparted that

[1] Strayer-Upton Arithmetics, Lower Grades, p. 238

temperature is measured by degrees and is listed under "Informational Matter in Statement Form". Again, the question is asked, "By what measures of weight are these things sold:- Butter, spices, coffee, meat, iron, large quantities of ice, small quantities of ice, pepper, hay?".[1] This is placed under the heading of "Informational Matter in Question Form".

Informational Matter in Statement Form found in Strayer-Upton.

Dry Measure:-

Fruits, grains, vegetables are measured by the
pint, the quart, the peck, and the bushel.
Also sold by the pound.

Liquid Measure:-

Milk is bought by the pint and quart;
Milk is bought by the gallon in large quantities;
Gasoline is bought by the gallon.

Measures of weight;

Ice is bought by the pound;
Ice is bought by the ton (large quantities);
Spices and pepper by the ounce;
Butter and meat by the pound;
Freight and express by the hundredweight;
Hundredweight is used in buying grain and cotton;
Hundredweight is used in selling milk to creamery;
Ton is used to weigh such things as coal and ice.

[1] Strayer-Upton Arithmetics, Lower Grades, p. 237 #2

Miscellaneous Measures:

Electricity	kilowatt hour (watt hour)
Gas	cubic feet
Lumber	board feet
Finishing lumber, molding	lineal foot
Temperature	Degree
Angles	degree
Freezing point of water	32 degrees F.
Boiling point of water	212 degrees F.
Blood heat	98½ degrees F.

Informational Matter in Question Form found in Strayer-Upton.

Telling ages of children, finding heights and weights.
What groceries are bought by the pound?
How are the following sold: butter, spices, coffee, meat, iron, large quantities of ice, small quantities of ice, pepper, hay?
Tell what unit of measure you use to find:
 The height of a door;
 The length of a carpet;
 The length of a house;
 The thickness of a board;
 The weight of a ship;
 The length of a road;
 The weight of a man;
 The length of a candle;
 The amount of coal you burn each winter;
 The amount of ice cream needed for 8 people;
 The distance from Chicago to San Francisco;
 The amount of gasoline used on an automobile trip.

UNITS OF MEASURE MERELY AS NAMES

Many of the written problems contain units of measure which, however, involve no computation or manipulation with denominate numbers or such. The units of measure are mentioned merely as words. The following problems might be cited to show the type of written problem involved: "Express the following lengths to the nearest tenth of a foot: 5.29 ft., 7.21 ft., 4.38 ft., 6.42 ft."[1] "How much must Mrs. King pay at the fish store for some codfish weighing 2 5/8 lb. and costing 19 ¢ a pound."[2] "The Woolworth Building in the city of New York is 792 ft. high. Jack's house is 72 ft. high. How many times as high as Jack's house is the Woolworth Building?"[3] "Mrs. Lee bought 3½ yd. of curtain goods. How many curtains, each 7/8 yd. long, can she make from this?"[4]

[1] Strayer-Upton, Middle Grades, p.216,#4
[2] Ibid. 88 #8
[3] " 32 #2
[4] " 212#5

TABLE XV. UNITS OF MEASURE AS WORDS IN STRAYER-UPTON

The table shows the frequency of occurrence of units of measure involving no computation with denominate numbers as such.

Linear Measure	
Inch	7
Feet	16
Yard	63
Mile	22
Square Measure	
Square yard	1
Acre	16
Cubic Measure	
Cubic foot	1
Dry Measure	
Quart	3
Bushel	5
Liquid Measure	
Pint	3
Quart	8
Gallon	8
Weight Measure	
Ounce	4
Pound	75
Ton	12
Counting	
Pair	24
Dozen	37

Time Measure

Seconds	1
Minutes	1
Hour	39
Day	32
Week	42
Month	25
Year	44

Miscellaneous Measures

Kilowatt hour	5
Cubic foot (gas)	1

TABLE FACTS IN EXAMPLES AND WRITTEN PROBLEMS- in Strayer-Upton Arithmetics

Tables XVI to XXI show the number of times a table fact or the reverse statement is called for in either examples or in written problems. For example, a table fact may be called for in an example of the following type: "How many square inches equal 1 square foot?"[1] Or a written problem may involve the knowledge of a table fact so that it may be solved, as for instance in the following written problem: "Mr. Archer finds that the distance around the deck of a steamship is 264 ft. How many times must he go around the deck to walk a mile?"[2] To solve this problem involves a knowledge of the fact that 5280 feet equal 1 mile.

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1. Strayer-Upton, Lower Grades, p.305 #1.
2. Strayer-Upton, Middle Grades, p.309 #4.

TABLE XVI. TABLE FACTS IN UNITED STATES MONEY ASKED IN EXAMPLES AND WRITTEN PROBLEMS- STRAYER-UPTON.

In each instance, the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 10 mills equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: What is one nickel equal to? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

10 mills=(1 cent)					1 mill=(1/10 cent)
5 cents=(1 nickel)			3	6	1 nickel= (5 cents)
10 cents=(1 dime)			3	5	1 dime=(10 cents)
25 cents=(1 quarter)			3	2	1 quarter=(25 cents)
50 cents=(½ dollar)			1	2	½ dollar=(50 cents)
100 cents=(1 dollar)			2		1 dollar=(100 cents)
10 dimes=(1 dollar)			1		1 dollar=(10 dimes)

TABLE XVII. TABLE FACTS IN LINEAR MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS- STRAYER-UPTON

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 12 inches equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: What is one foot equal to? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

12 inches=(1 foot)			3		1 foot=(12 inches)
36 inches=(1 yard)			5		1 yard= (36 inches)
3 feet=(1 yard)					1 yard=(3 feet)
16½ feet=(1 rod)			1		1 rod=(16½ feet)
5280 feet=(1 mile)			3	1	1 mile=(5280 feet)
5½ yards=(1 rod)					1 rod=(5½ yards)
			1	1	1 mile=(1760 yards)
320 rods=(1 mile)			1		1 mile=(320 rods)

TABLE XVIII. TABLE FACTS IN SQUARE MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS- STRAYER-UPTON

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 144 square inches equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: What is 1 square foot equal to? Frequency of occurrence is shown in the column of cells to the right. The frequency os occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell.

144 sq. in.=(1 sq.ft.)		1	1 sq.ft.=(144 square in.)
9 sq.ft.=(1 sq.yd.)		1	1 sq.yd.=(9 sq.ft.)
30¼ sq.yd.=(1 sq.rd.)			1 sq.rd.=(30¼ sq.yd.)
160 sq.rd.=(1 A.)			1 A.= (160 sq.rd.)
640 A.=(1 sq.mi.)			1 sq.mi.=(640 A.)
36 sq.mi.= (1 tp.)			1 tp.=(36 sq.mi.)

TABLE XIX. TABLE FACTS IN DRY MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS- STRAYER-UPTON

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 2 pints equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: How many pints are there in one quart? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

2 pints=(1 quart)			1 quart=(2 pints)
8 quarts=(1 peck)		1	1 peck=(8 quarts)
4 pecks=(1 bushel)			1 bushel=(4 pecks)

TABLE XX. TABLE FACTS IN LIQUID MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS -- STRAYER-UPTON

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 2 pints equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: One quart is equal to how many pints? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

2 pints=(1 quart)		1	1 quart=(2 pints)
4 quarts=(1 gallon)		1	1 gallon=(4 quarts)

TABLE XXI. TABLE FACTS IN TIME ASKED IN EXAMPLES AND WRITTEN PROBLEMS - STRAYER-UPTON

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus:What are 60 seconds equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: How many seconds in 1 minute? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

60 seconds=(1 minute)			1 minute=(60 seconds)
60 minutes=(1 hour)			1 hour=(60 minutes)
24 hours=(1 day)			1 day=(24 hours)
7 days=(1 week)		9	1 week=(7 days)
365 days=(1 year)			1 year=(365 days)
366 days=(1 lp.year)			1 year=(366 days)
52 weeks=(1 year)		2	1 year=(52 weeks)
12 months=(1 year)		1	1 year=(12 months)
100 years=(1 century)			1 century=(100 years)

REDUCTION OF DENOMINATE NUMBERS

Reduction of denominate numbers is the process of changing their denomination without changing their value. Denominate numbers may be changed from a higher to a lower denomination, as for example, when 2 miles are reduced to feet; denominate numbers may also be changed from a lower to a higher denomination, as when 21 pints are reduced to gallons. The former process is known as descending reduction; the latter, as ascending reduction.

Meaning and Reading of Tables XXII to XXXIII.

The upper figure shows descending reductions. The unit of measure at the head of the column of vertical squares in these figures read in connection with each of the cells in these columns indicate the denomination from which the reduction is made; when these terms are read in connection with the row of horizontal cells to the left, they indicate the denomination to which the reduction is made.- The lower figures show ascending reductions. The unit of measure read in connection with the horizontal rows of cells to the right indicate the denomination from which the reduction is made; read in

connection with the vertical column of cells it refers to the unit to which the ascending reduction is made. Frequency of occurrence of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell.

TABLE XXII. REDUCTIONS IN UNITED STATES MONEY
STRAYER-UPTON

The upper figure Fig a shows descending reductions; the lower figure Fig b ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of cell; those appearing in written problems in lower right. For further details as to meaning and reading of table see page 32.

	Dollars	Half dollars	Quarters	Dimes	Nickels
Half dollars					
Quarters					
Dimes		1			
Nickels		 1	 1		
Cents		1	2 2	7 1	3 3

Fig. a.

	Nickels	Dimes	Quarters	Half dollars	Dollars
Half dollars					
Quarters				1	
Dimes					1
Nickels			1	1	
Cents	 2	5 1			4

Fig. b.

TABLE XXIII. REDUCTIONS IN LINEAR MEASURE*STRAYER-UPTON

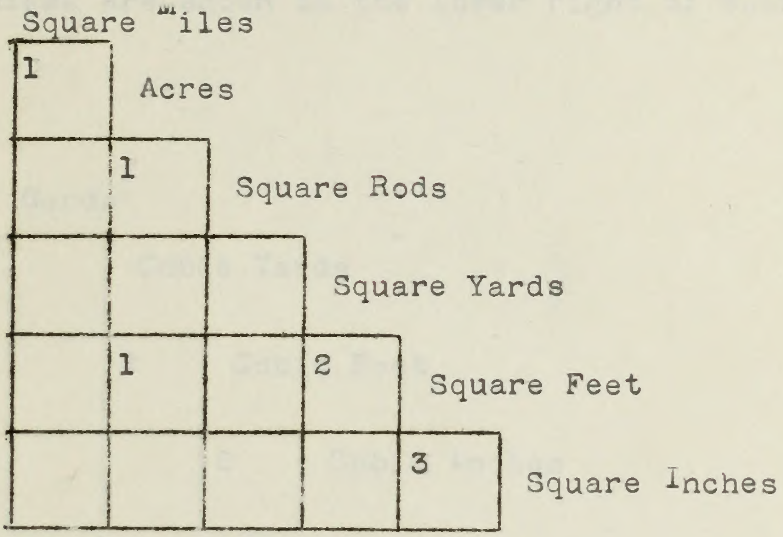
The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; those appearing in written problems are shown in the lower right of each square. For further details as to meaning and reading of tables see page 32.

	Miles	Rods	Yards	Feet
Rods	2			
Yards	2	1		
Feet	6	 1	9 3	
Inches	1		3	6 2

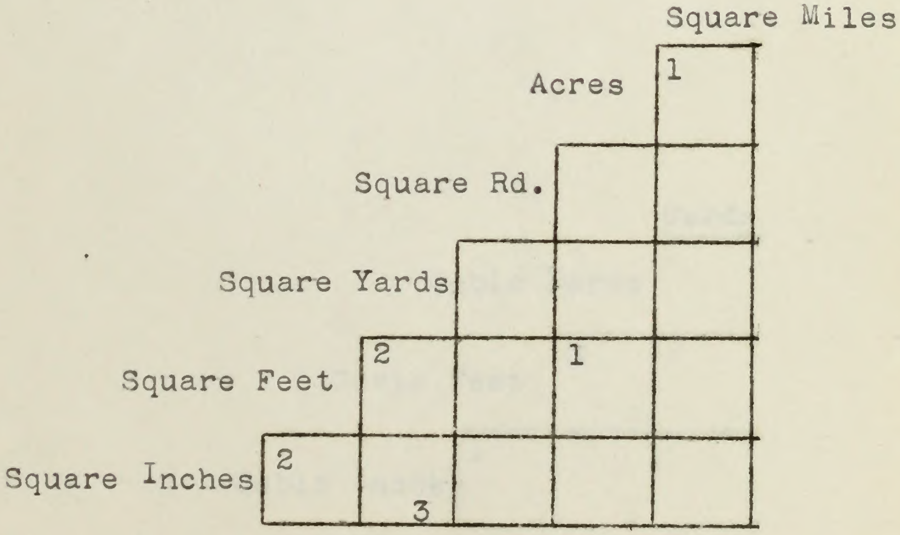
	Feet	Yards	Rods	Miles
Rods				1
Yards				 1
Feet		8 3		 1
Inches	7	4 5		

TABLE XXIV. REDUCTIONS IN SQUARE MEASURE*STRAYER-UPTON

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; those appearing in written problems are shown in the lower right of each square. For further details as to meaning and reading of table see page 32.



	Square Miles	Acres	Square Rods	Square Yards	Square Feet
Acres	1				
Square Rods		1			
Square Yards					
Square Feet		1		2	
Square Inches					3



	Square Feet	Square Yards	Square Rd.	Acres	Square Miles
Acres					1
Square Rd.					
Square Yards					
Square Feet		2		1	
Square Inches	2	3			

TABLE XXV. REDUCTIONS IN CUBIC MEASURE- STRAYER-UPTON

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell.

	Cords	Cubic Yards	Cubic Feet
Cubic Yards			
Cubic Feet		2	
Cubic Inches			2

	Cubic Feet	Cubic Yards	Cords
Cubic Yards			
Cubic Feet		3	
Cubic Inches	1		

TABLE XXVI. REDUCTIONS IN DRY MEASURE: STRAYER-UPTON

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; those appearing in written problems are shown in the lower right of each square. For further details as to reading and meaning of table see page 32.

	Bushels	Pecks	Quarts
Pecks	1 2		
Quarts	6 4	5 2	
Pints	1 1		

	Quarts	Pecks	Bushels
Pecks			2 3
Quarts		1 2	4 1
Pints	 3		1

TABLE XXVII. REDUCTIONS IN LIQUID MEASURE- STRAYER-UPTON

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell. For further details as to reading and meaning of table see page 32.

	Barrels	Gallons	Quarts	Pints
Gallons				
Quarts	/ 1	9 / 2		
Pints		9 / 1	4 / 1	
Cups or Glasses			2 / 2	

	Pints	Quarts	Gallons	Barrels
Gallons				/ 1
Quarts			5 / 5	
Pints		2 / 2		/ 2
Cups or Glasses		/ 4		

TABLE XXVIII. REDUCTIONS IN WEIGHT MEASURES- STRAYER-UPTON.

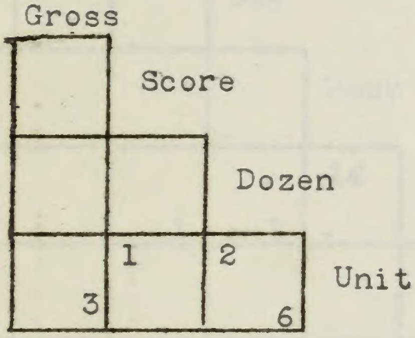
The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; Those appearing in written problems are shown in the lower right of each square. For further details as to reading and meaning of table see page 32.

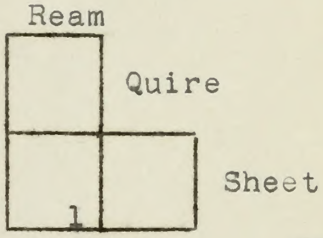
	Tons	Cwt.	Pounds
Cwt.			
Pounds	4 1	2	
Ounces			27 1

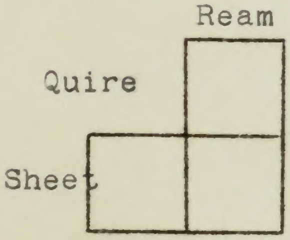
	Pounds	Cwt.	Tons
Cwt.			1
Pounds		8	2 9
Ounces	20 2		

TABLE XXIX. REDUCTIONS IN COUNTING- STRAYER-UPTON

The upper figures show descending reductions; the lower figures descending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell.







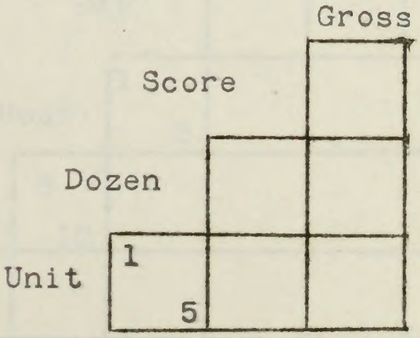


TABLE XXX. REDUCTIONS IN TIME- STRAYER-UPTON

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell. Further details as to meaning and reading of table may be found on page 32.

Century							
Year	/ 1						
Month		2 /					
Week							
Day				4 /			
Hour		/ 2					
Minute		/ 1		/ 1	/ 1	14 /	
Second							5 / 1

Year							
Month						/ 1	
Week							
Day				4 /		/ 1	
Hour			1 / 2				
Minute		8 / 10					
Second	4 / 2						

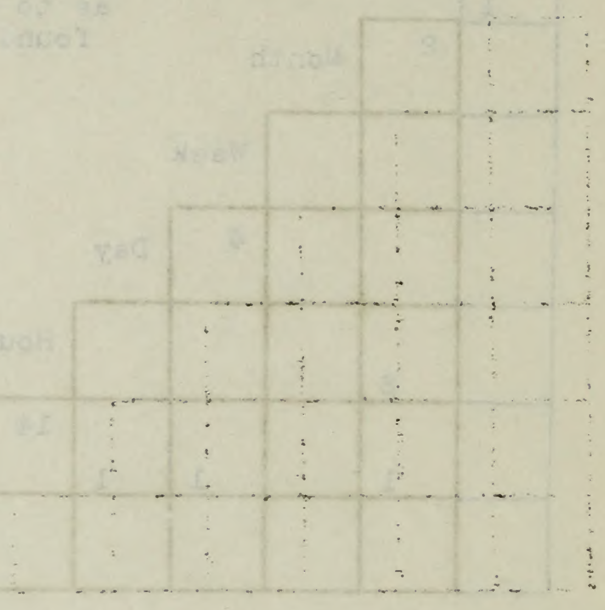


TABLE XXXI . REDUCTIONS IN MEASURES OF CONTENT AND CAPACITY- STRAYER-UPTON

The upper figure shows reductions from pints, gallons, etc. to cubic feet and cubic inches and the frequency of their occurrence. The lower figure shows the reverse, that is, the changes of cubic feet and cubic inches to pints, gallons etc. Those occurring in examples are shown in the upper left of the cell; those occurring in written problems in the lower right of each cell.

Pints	Gallons	Bushels	Pounds	Tons	
	8	1		1	Cubic Feet
	2				Cubic Inches

	Pints	Gallons	Bushels	Pounds	Tons
Cubic Feet		1 16	6 5	21	2
Cubic Inches	1	2			

TABLE XXXII. REDUCTIONS IN METRIC MEASURES- STRAYER-UPTON

Reductions from metric measures to English equivalents and visa versa. The former are shown in the upper figures, namely in fig. 1, fig.5 and fig. 6; the latter in the lower figures, fig. 4, fig.7 and fig. 8.

Km.	Dm.	m.	dm.	
3				Miles
		3		Yards
		1		Feet
				Inches

Fig. 1. Length

Fig. 2.

Fig. 3.

	Km.	Dm.	m.	dm.
Miles				
Yards				
Feet				
Inches				

Fig. 4.

TABLE XXXII. (Continued)

Liter	Hl.	
		Quart
		Gallon
		Bushel

Fig. 5. Capacity

M.T.	Kg.	
		Pound
	2	Ton

Fig. 6. Weight

	M.T.	Kg.
Pound		
Ton		

Fig. 7. Weight

	Liter	Hl.
Quart	1	
Gallon		
Bushel		

Fig. 8. Capacity

TABLE XXXIII. REDUCTIONS IN MISCELLANEOUS MEASURES-STRAYER-UPTON

Fig. 1 and 2 show changes from knots, leagues to miles; and bushels, pecks to pounds and ounces; fig. 3 and 4 show the reverse process, namely changes from pounds, ounces to bushels, pecks etc.

Bushels	Pecks	Pints	Gallons	Barrels	Bales	
5				1		Pounds
		1				Ounces

Fig. 1

Knots	Leagues	
3		Miles

Fig. 2

Fig. 3

	Bushels	Pecks	Pints	Gallons	Barrels	Bales
Pounds	4					
Ounces						

Fig. 4

COMPUTATION WITH DENOMINATE NUMBERS

Generally speaking, denominate numbers are of two kinds, namely, simple denominate numbers and compound denominate numbers. Simple denominate numbers consist of units of measure of but one denomination, as, 1 inch. Compound denominate numbers consist of two or more units of measure of the same kind, such as, 2 yards 3 feet 5 inches. Lennes calls numbers involving two or more units of different kinds, as for example those expressed in "miles per hour", "ton-miles" etc. "quasi-denominate" numbers.[1]

Computation in the fundamental processes involving these three types of denominate numbers and the frequency of their occurrence are shown in Tables XXXIV to XXXVI.

Written problems in connection with the clock and the calendar which involve computation, are grouped separately under Time.

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1. Lennes, N. J. The Teaching of Arithmetic, page 281.

TABLE XXXIV. COMPUTATION WITH SIMPLE DENOMINATE NUMBERS

STRAYER- UPTON

The first column marked "Addition" shows the number of occurrences of computation in adding the denominate numbers involving the units of measure listed to the left of the figure; the second column shows the number of occurrences in subtraction, etc. Examples shown in upper left of cell; written problems in lower right of each cell.

	Addition	Subtraction	Multipli-tion	Division
Inches	16	6	4	8
Feet	5	1 13	18	12
Yards	1 9	1 1	3	2
Miles	11	35	9	2
Acres	4	1		
Square Miles			1	
Quart (Dry)			3	
Peck			1	
Bushel	1		2	1
Pint (Liquid)			1	
Gallon			1	
Barrel				1

TABLE XXXIV (Continued)

	Addition	Subtraction	Multiplication	Division
Ounce			2	
Pound	1 33	1 37	18	14
Dozen	6		1	
Seconds	1 4	3		
Minutes	2	3	3	2
Hours	1 15	2	5	3
Days		3	3	
Years		2		
Clock-Calendar Minutes-Sec.	1	2		
Hours-Min.	4	9	2	
Month-Day		1		
Yr.Mo.Day		1		

TABLE XXXIV (Continued)

	Addition	Subtraction	Multiplication	Division
Degree(Temp)		5		
Cu.Ft.(gas)		10		
Kilowatt	1	2	31	

TABLE XXXV. COMPUTATION WITH "QUASI-DENOMINATE" NUMBERS-STRAYER-UPTON

The first column marked "Addition" shows the number of occurrences of computation in adding the denominate numbers involving the units of measure listed to the left of the figure; the second column shows the number of subtraction computations, etc. Examples are shown in upper left of the cell; written problems in lower right of each cell.

	Addition	Subtraction	Multiplication	Division
Feet per second		1		1
Yards per second	2	10		1
Miles per second			1	
Miles per minute			1	6
Miles per hour	1	2	18	36
Miles per day	4		3	14
Knots per hour			1	1
Km. per hour				1
Miles per gallon			3	21
Bushels per acre			1	

Boston University
School of Education

TABLE XXXVI. COMPUTATION WITH COMPOUND DENOMINATE NUMBERS-STRAYER-UPTON

The first column marked "Addition" shows the number of occurrences of computation in adding the denominate numbers involving the units of measure listed to the left of the figure; the second column shows the number of subtraction computations, etc. Examples are shown in upper left of the cell; written problems in lower right of each cell.

	Addition	Subtraction	Multiplication	Division
Feet inches	5 1	1 22	3 1	 4
Yards inches	1	 1	1	
Yards feet	2	1	1	
Mi.rd.yd.ft.in.			 1	
Bushels pecks	1			
Pecks quarts		1		
Gallons quarts	 1		1	
Pounds ounces	1 2	1 3	1 5	
Days hours	 1			 1
Hours minutes	2 3	1	1	 2

SUMMARY OF THE STRAYER-UPTON ARITHMETIC SERIES

In Table xxxvii we have a summary of the data gathered with reference to the denominate numbers found in the Strayer-Upton Arithmetic Series. The data has been gathered under five headings. One group of facts has been omitted from this summary, namely, "Informational Matter With Reference To Denominate Numbers". The reader may refer to pages 19 to 21 for this data.

Reading and Meaning of Table XXXVII.

The tables of measures involved in the summary are listed to the left of the figure. Column 1 shows the number of equalities found in each of the tables; column 2 shows the number of units of measure used as mere words, while column 3 shows the number of written problems involved; in column 4 we find the number of table facts asked in examples and written problems and column 5 shows the number of examples and written problems involved;x column 6 shows the total number of reductions, while column 7 shows the number of examples and written problems involved in these reductions; column 8 shows the number of units of measure used in computation and column 9 the number of examples and written problems involved in computation with simple denominate numbers; column 10 shows the number of compound denominate numbers used and the final column the number of examples and written problems involved in computation with compound denominate numbers.

x Examples upper left, W.P. lower right

SUMMARY OF STRAYER-UPTON. TABLE XXXVII.

For reading and meaning of table, see page 53.

	1 Equality	2 Word	3 Examples +WP	4 Table Facts	5 Examples +WP	6 Reductions	7 Examples +WP	8 Computation	9 Examples +WP	10 Compound	11 Examples +WP
U. S. Money	6			6	13 15	14	27 11				
Linear	7	4	108	6	14 2	15	50 16	4	4 145	4	15 30
Square	6	2	17	2	2	11	14 4	2	6		
Cubic	2	1	1			4	8				
Dry	3	2	8	1	1	9	21 18	3	8	2	2
Liquid	2	3	21	2	2	10	31 21	3	3	1	1 1
Weight	3	3	91			5	61 24	2	2 104	1	3 10
Counting	7	2	61			5	4 15	1	7		
Time	10	7	184	3	12	16	43 23	5	50	2	4 7
Clock Calendar								4	20		
Capacity Content						10	8 59				
Metric	10										
English Equivalents	3					5	10				
Quasi-Den.No.								10	129		
Misc.Measures	20	2	6					3	50		

TABLE XXXVIIA. DETAILED SUMMARY OF REDUCTIONS- Strayer-Upton

Column one shows the total number of descending reductions with reference to each table of measure listed to the left of the figure. The second column shows the total number of examples (upper left of cell) and the total number of written problems (lower right of cell). Column 3 and 4 show similar data for ascending reductions.

	Desc. Reduct.	Examples + WP	Asc. Reduct.	Examples + WP
United States Money	7	14 8	7	13 3
Linear Measure	9	30 6	6	20 10
Square Measure	6	8	6	6 4
Cubic Measure	2	4	2	4
Dry Measure	4	13 9	5	8 9
Liquid Measure	5	24 7	5	7 13
Weight Measure	2	31 2	3	30 12
Counting	4	3 10	1	1 5
Time	10	25 8	6	18 15
Engl.Eq.ofMetric Weights	4	 9	1	 1
Capacity and Content	4	1 12	6	7 47
Misc. Measures	4	6 4	1	 4

PART TWO

The following analysis covers the units of weight and measure, with special reference to denominate numbers, as found in the three book series of the New Everyday Arithmetic, or as they will be called in this study Hoyt-Peet.

RELATIONS AMONG UNITS OF MEASURE

Tables XXXVIII - XLIX which follow show the various tables of measures found in the New Everyday Arithmetic or Hoyt-Peet, each Table representing one table of measure, except that counting articles and counting paper have been grouped together in one table, as have also the various measures of the Metric system. In each case the equalities found in the table of measure has been stated to the left of the figure and the frequency of occurrence of these equalities is indicated in the upper left corner of the corresponding square. All other relations found in the texts of the Hoyt-Peet Series are listed to the right and the frequency of occurrence of these equalities, either in written problems or in some other isolated form, is recorded in the lower right of the cell.

The Hoyt-Peet Series uses the puzzle element to introduce tables of weight and measure. One of the numbers in each relation of the table is omitted, for instance, "-- inches = 1 foot".[1] The pupil is asked to "complete the table". This is merely a variation in the method of introducing children to the relations in the tables of weights and measures.

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[1] Hoyt-Peet, Second Book, p. 144

TABLE XXXVIII. RELATIONS AMONG UNITS OF UNITED STATES MONEY FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

10 mills = 1 cent	1	1 mill = 1/10 cent
5 cents = 1 nickel		1 nickel = 5 cents
10 cents = 1 dime		1 dime = 10 cents
25 cents = 1 quarter		1 quarter = 25 cents
50 cents = ½ dollar		½ dollar = 50 cents
100 cents = 1 dollar		1 dollar = 100 cents
10 dimes = 1 dollar		1 dollar = 10 dimes
Total	1	

TABLE XXXIX. RELATIONS AMONG UNITS OF LINEAR MEASURE FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

12 inches = 1 foot	2		1 foot = 12 inches
36 inches = 1 yard			1 yard = 36 inches
3 feet = 1 yard	2		1 yard = 3 feet
16½ feet = 1 rod	3	1	1 rod = 16½ feet
5280 feet = 1 mile	2	4	1 mile = 5280 feet
5½ yards = 1 rod		1	1 rod = 5½ yards
1760 yards = 1 mils		1	1 mile = 1760 yards
320 rods = 1 mile			1 mile = 320 rods
Total	9	7	

TABLE XL. RELATIONS AMONG UNITS IN SQUARE MEASURE FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

144 sq.in. = 1 sq.ft.		1 sq.ft. = 144 sq.in.
9 sq.ft. = 1 sq.yd.		1 sq.yd. = 9 sq.ft.
30¼ sq.yd. = 1 sq.rd.		1 sq.rd. = 30¼ sq.yd.
160 sq.rd. = 1 acre	1	1 acre = 160 sq.rd.
43,560 sq.ft. = 1 acre	3	1 acre = 43,560 sq.ft.
209 ft. square = 1 acre	1	1 acre = 209 ft. square
640 acres = 1 sq.mi.		1 sq.mi. = 640 acres
Total	5	

TABLE XLI. RELATIONS AMONG UNITS IN CUBIC MEASURE FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

1728 cu.in. = 1 cu.ft.	1		1 cu.ft. = 1728 cu.in.
27 cu.ft. = 1 cu.yd.	1		1 cu.yd. = 27 cu.ft.
		1	128 cu.ft. = 1 cord
Total	2	1	

TABLE XLII. RELATIONS AMONG UNITS IN DRY MEASURE FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

2 pints = 1 qt.	1	1 qt. = 2 pt.
8 qt. = 1 pk.	1	1 pk. = 8 qt.
4 pk. = 1 bu.	1	1 bu. = 4 pk.
Total	3	

TABLE XLIII. RELATIONS AMONG UNITS IN LIQUID MEASURE FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

2 pt. = 1 qt.	1	1 qt. = 2 pt.
4 qt. = 1 gal.	1	1 gal. = 4 qt.
Total	2	

TABLE XLIV. RELATIONS AMONG UNITS IN MEASURES OF WEIGHT FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

16 oz. = 1 lb.	2	2	1 lb. = 16 oz.
100 lb. = 1 cwt.	1		1 cwt. = 100 lb.
2000 lb. = 1 T.	1		1 T. = 2000 lb.
Total	4	2	

TABLE XLV. RELATIONS AMONG UNITS IN TABLES OF COUNTING FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrences is shown in lower right of cell. Blank indicates no occurrence.

12 units - 1 doz.	1	1	1 doz. - 12 units
144 units - 1 gross	1		1 gross - 144 units
12 doz. - 1 gross	1		1 gross - 12 doz.
20 units - 1 score			1 score - 20 units
Total	3	1	

24 sheets - 1 quire			1 quire - 24 sheets
480 (500) sheets - 1 ream			1 ream - 480 (500) sheets
20 quires - 1 ream			1 ream - 20 quires

TABLE XLVI. RELATIONS AMONG UNITS IN MEASURES OF TIME FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures; frequency of occurrence is shown in upper left of each cell. All other equalities found in the texts are listed to the right; frequency of occurrence is shown in lower right of cell. Blank indicates no occurrence.

60 seconds - 1 minute	1		1 minute - 60 seconds
60 minutes - 1 hour	1		1 hour - 60 minutes
24 hours - 1 day	1		1 day - 24 hours
7 days - 1 week	1		1 week - 7 days
365 days - 1 year	1		1 year - 365 days
366 days - 1 leap year	1		1 leap year - 366 days
		1	4 weeks - 1 month
52 weeks - 1 year		3	1 year - 52 weeks
12 months - 1 year		1	1 year - 12 months
100 years - 1 century			1 century - 100 years
Total	6	5	

TABLE XLVII. RELATIONS AMONG UNITS OF METRIC MEASURES FOUND IN THE HOYT-PEET SERIES.

Equalities to the left are found in tables of measures. Frequency of occurrence of these table facts is noted in upper left of cell.

10 mm. = 1 cm.	1
10 cm. = 1 dm.	1
10 dm. = 1 m.	1
10 m. = 1 Dm.	1
10 Dm. = 1 Hm.	1
10 Hm. = 1 Km.	1
10 Km. = 1 Mm.	1
Total	7

Fig. 1. Length

TABLE XLVII (CONTINUATION)

Equalities to the left are found in tables of measures. Frequency of occurrence of these table facts is noted in upper left of cell.

100 sq. mm. = 1 sq. cm.	1
100 sq. cm. = 1 sq. dm.	1
100 sq. dm. = 1 sq. m.	1
100 sq. m. = 1 sq. Dm.	1
100 sq. Dm. = 1 sq. Hm.	1
100 sq. Hm. = 1 Km.	1
Total	6

Fig. 2. Square Measure

TABLE XLVII (CONTINUATION)

Equalities to the left are found in tables of measures. Frequency of occurrence of these table facts is noted in upper left of cell.

1000 cu. mm. = 1 cu. cm.	1
1000 cu. cm. = 1 cu. dm.	1
1000 cu. dm. = 1 cu. m.	1
Total	3

Fig. 3. Cubic Measure

TABLE XLVII (CONTINUATION)

Equalities to the left are found in tables of measures. Frequency of occurrence of these table facts is noted in upper left of cell.

10 ml. = 1 cl.	1
10 cl. = 1 dl.	1
10 dl. = 1 l.	1
10 l. = 1 Dl.	1
10 Dl. = 1 Hl.	1
Total	5

Fig. 4. Capacity

TABLE XLVII (CONTINUATION)

Equalities to the left are found in tables of measures. Frequency of occurrence of these table facts is noted in upper left of cell.

10 cg. = 1 dg.	1
10 dg. = 1 g.	1
10 g. = 1 Dg.	1
10 Dg. = 1 Hg.	1
10 Hg. = 1 Kg.	1
10 Kg. = 1 Mg.	1
10 Mg. = 1 Q.	1
10 Q. = 1 M.T.	1
Total	8

Fig. 5. Weight

TABLE XLVIII. RELATIONS BETWEEN UNITS OF METRIC MEASURES AND ENGLISH MEASURES FOUND IN HOYT-PEET.

Equalities to the left are found in table of measure. Frequency of occurrence of these table facts is noted in upper left of cell.

1 m. = 39.37 in.	1
1 Km. = .62 mi. 5/8 mi.	1
1 Ha. = 2.47 acres	1
1 l. = .91 qt. 9Dry)	1
1 l. = 1.06 qt. (Liquid)	1
1 Hl. = 2.84 bu.	1
1 Kg. = 2.2 lb.	1
1 M.T. = 1.1 T	1
Total	8

TABLE XLIX. RELATIONS IN MISCELLANEOUS MEASURES FOUND IN THE HOYT-PEET SERIES.

This table shows relations in miscellaneous measures and the frequency of their occurrence in the Hoyt-Peet Arithmetics.

Linear Measure	
1 Knot = 1.1516 statute miles	1
Capacity and Content	
1 cu. ft. water = $62\frac{1}{2}$ lb.	1
12 cu. ft. air = 1 lb.	1
5 cu. ft. wheat = 4 bu.	1
5 cu. ft. ear corn = 2 bu.	1
1 bu. = 2150.42 cu. in.	3
1 bu. = $1\frac{1}{4}$ cu. ft.	1
1 bu. corn (shelled) = 56 lb.	2
1 bu. potatoes = 60 lb.	1
1 gal. water = 231 cu. in.	3
1 bbl. flour = 196 lb.	1
1 glass = $\frac{1}{2}$ pt.	1
Weight	
1 long ton = 2240 lb.	1
1 short ton = 2000 lb.	1
360 degrees = 1 circle	2

INFORMATIONAL MATTER WITH REFERENCE TO UNITS OF MEASURES.

Since the actual use of units of weight and measure is always in connection with articles and commodities, an understanding of the meaning and use of units of weight and measure can only come through commodities. As soon as a commodity is thoroughly understood, the appropriate unit of measure to be used in connection with it has been learned incidentally.

Units of weight and measure are not learned as such, but in connection with commodities. It is this idea of the connection or inter-relation between commodities and units of weight and measure that the expression "informational matter", used here in connection with denominate numbers, is meant to convey. No manipulation or computation with denominate numbers is involved, but simply an understanding that a given unit of measure is used in connection with a given commodity.

The instances in which nothing more is involved than an understanding of the meaning of a unit of measure through its use with a commodity, have been gathered and grouped under two headings, namely, those appearing in statement form and those appearing in question form.

For instance, the statement is made that "In measuring land and other surfaces, the square inch, the square foot, and the square yard are used."[1] The information is imparted that square measures are used to measure surfaces and is, therefore, listed under "Informational Matter in Statement Form". Again, the question is asked, "What are the measures that are commonly used for apples, potatoes, wheat, and other fruits, vegetables, and grains?"[2] This is placed under the heading of "Informational Matter in Question Form.

Informational Matter in Statement Form found in Hoyt-Peet.

Money:

The mill, the thousandths part of a dollar, is often used in the calculations of business men and public officials.

The standard foreign coins are the following:
British pound sterling
British shilling
German mark
French franc
Italian lira
Russian ruble
Spanish peseta
Mexican peso

Square Measure:

In measuring surfaces the square units used are the square inch, the square foot, the square yard, the square rod, the acre, and the square mile.

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1. Hoyt-Peet, Second Book, page 148.
2. " " " " " 151.

Cubic Measure:

In measuring the contents of a box, a grain bin, a wagon, or a freight car, cubic units are sometimes used.

Weight Measure:

Freight is shipped by the hundredweight; also by the net ton (2000lb.) and the gross ton (2240)lb.

Liquid Measure:

Milk is bought in pint or quart bottles.

Counting:

Shoes are bought in pairs.

Time:

A month counting 30 or 31 days (28 or 29 in Feb.) is called a calendar month; one counting 4 weeks is called a lunar month.

Miscellaneous Measures:

Angles are measured by degrees;
Electrical energy is measured by the watt or kilowatt.
Origin of the thermometer and the reason for dividing it as it is.

Metric measures:

In measuring land, the square Dm. is called an are; the square Hm. is called hektare.

In measuring wood the cubic meter is called a stere.

How the length of the meter was arrived at.

Informational Matter in Question Form found in Hoyt-Peet.

Name the coins used in buying and selling;
What unit of measure do you use in measuring height?
What measure is used in selling cloth?
Name measure used in finding the length of cloth; the width?
What measure is used for the depth of a building lot?
What measure is used for the width of a field?
What measure is used for finding distances between cities?

What unit is used for railway distances?
Pace and measure a distance one rod long.
Name a place 1 mile from school.
Which units would one use in measuring the surface of a small sheet of silver?
In measuring the area of a room; of a sidewalk; of a field, of a building lot, of a farm? Which unit is used for the area of a continent or an ocean?
What unit of measure is used for apples, potatoes, wheat, oats, fruits, vegetables, and grains?
What unit of measure is used in computing quantity of earth excavated?
By what weight is butter sold?
What unit of measure is used in measuring one's weight?
What units of measures are used in mixing a cake? in canning fruit?
What unit of weight is used for first call mail; for parcel post; for hay?
By what unit of measure are eggs sold? name fruits that are sold by the same measure.
In selling screws and other small articles, what name is given to 12 dozen?
What units of measure are used for giving one's age?
Name units of measure used for each of the following: electricity, area of a farm, area of a room, coal, wheat, potatoes, oranges, sugar, hay, strawberries, peaches, time, gas, rainfall, temperature, land, distance at sea, speed of a ship, height above sea level?

UNITS OF MEASURE MERELY AS NAMES

Many of the written problems contain units of measure which, however, involve no computation or manipulation with denominate numbers or such. The units of measure are mentioned merely as words. The following problems might be cited to show the type of written problem involved: "Some of the fast vessels in the United States Navy travel at the rate of 22.5 knots or 25.911 miles, per hour."[1] "Two pounds of candy are to be put into boxes holding half pound each. How many boxes are needed?"[2] "A railway was built at the cost of $24,000 per mile. At that rate, how many miles of railway can be built for $2,400,000?"[3]

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[1] Hoyt-Peet, Second Book, page 203, #16
[2] Ibid. page 135, #1
[3] " " 83, #18

TABLE L. UNITS OF MEASURE AS WORDS IN HOYT-PEET

The table shows the frequency of occurrence of units of measure involving no computation with denominate numbers as such.

Linear Measure	
Inches	38
Feet	29
Yards	112
Miles	35
Square Measure	
Acres	17
Sq. Miles	5
Cubic Measure	
Cord	1
Dry Measure	
Quarts	3
Pecks	2
Bushels	34
Liquid Measure	
Pints	3
Quarts	16
Gallons	12
Weight Measure	
Pounds	121
Ounces	1
Ton	13
Counting	
Pair	35
Dozen	62
Time	
Seconds	1
Minutes	40
Hours	61
Days	44
Week	50
Month	21
Year	24
Miscellaneous Measures	
Knots	1
Cu. ft. (gas)	3
Kwt.	8
Barrel	17
Bales	3

TABLE FACTS IN EXAMPLES AND WRITTEN PROBLEMS

Tables LI to LIX show the number of times a table fact or the reverse statement is called for either in examples or in written problems. For example, a table fact may be called for in an example of the following type, "How many inches in one foot?" Or a written problem may involve the knowledge of a table fact so that it may be solved, as for instance in the following written problem: "Mr. Archer finds that the distance around the deck of a steamship os 264 ft. How many times must he go around the deck to walk a mile? To solve this problem involves a knowledge of the fact that there are 5280 feet in one mile.

TABLE LI. TABLE FACTS IN UNITED STATES MONEY ASKED IN EXAMPLES AND WRITTEN PROBLEMS - HOYT-PEET

In each instance, the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 10 mills equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of figure thus: What is one nickel equal to? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

10 mills =(1 cent)					1 mill = (1/10 cent)
5 cents = (1 nickel)			13	1	1 nickel = (5 cents)
10 cents = (1 dime)			18	1	1 dime = (10 cents)
25 cents = (1 quarter)			21	5	1 quarter = (25 cents)
50 cents = (½ dollar)			7	3	½ dollar = (50 cents)
100 cents =(1 dollar)					1 dollar = (100 cents)
10 dimes =(1 dollar)					1 dollar = (10 dimes)

TABLE LII. TABLE FACTS IN LINEAR MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS- HOYT-PEET

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus : What are 12 inches equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: What is one foot equal to or how many inches are there in one foot? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of cell. Blank indicates no occurrence.

12 inches= (1 foot)		7	1 foot= (12 inches)
3 feet= (1 yard)		7	1 yard= (3 feet)
16½ Feet= (1 rod)		1	1 rod= (16½ feet)
5280 feet= (1 mile)		1 1	1 mile= (5280 feet)
5½ yards= (1 rod)			1 rod= (5½ yards)
1760 yards=(1 mile)		 1	1 mile= (1760 yards)
320 rods= (1 mile)			1 mile= (320 rods)

TABLE LIII. TABLE FACTS IN SQUARE MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS- HOYT-PEET

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 144 square inches equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: What is 1 square foot equal to? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell.

144 sq. in. = (1 sq. ft.)			1 sq. ft. = (144 sq. in.)
9 sq. ft. = (1 sq. yd.)			1 sq. yd. = (9 sq. ft.)
30¼ sq. yd. = (1 sq. rd.)			1 sq. rd. = (30¼ sq. yd.)
160 sq. yd. = (1 A.)			1 A. = (160 sq. yd.)
640 A. = (1 sq. mi.)			1 sq. mi. = (640 A.)
36 sq. mi. = (1 tp.)			1 tp. = (36 sq. mi.)

TABLE LIV. TABLE FACTS IN CUBIC MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS - HOYT-PEET

In each instance, the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 1728 cu. in. equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: How many cu. in. in one cu. ft.? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

1728 cu. in = (1 cu.ft.)		1	1 cu. ft. = (1728 cu. in.)
27 cu. ft. = (1 cu. yd.)		1	1 cu. yd. = (27 cu. ft.)

TABLE LV. TABLE FACTS IN DRY MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS - HOYT-PEET

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 2 pints equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: How many pints are there in one quart? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

2 pins = (1 quart)			2		1 quart = (2 pints)
8 quarts = (1 peck)			5	5	1 peck = (8 quarts)
4 pecks = (1 bushel)			4	11	1 bushel = (4 pecks)

TABLE LVI. TABLE FACTS IN LIQUID MEASURE ASKED IN EXAMPLES AND WRITTEN PROBLEMS - HOYT-PEET

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 2 pints equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: One quart is equal to how many pints? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell; Blank indicates no occurrence.

2 pints = (1 quart)		3	1 quart = (2 pints)
4 quarts = (1 gallon)		3 1	1 gallon = (4 quarts)

TABLE LVII. TABLE FACTS IN MEASURE OF WEIGHT ASKED IN EXAMPLES AND WRITTEN PROBLEMS - HOYT-PEET

In each instance, the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 16 oz. equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: How many oz. in 1 pound? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

16 ounces = (1 pound)		3	1 pound = (16 ounces)
100 lb. =(1 cwt.)		1	1 cwt. = (100 lb.)
2000 pounds = (1 ton)		2	2000 pounds = (1 ton)

TABLE LVIII. TABLE FACTS IN COUNTING ASKED IN EXAMPLES AND WRITTEN PROBLEMS - HOYT-PEET

In each instance, the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 12 equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: How many equal one dozen? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

12 = (1 dozen)			3	16	1 dozen = (12)
144 = (1 gross)					1 gross = (144)
12 dozen = (1 gross)				1	1 gross = (12 dozen)

TABLE LIX. TABLE FACTS IN TIME ASKED IN EXAMPLES AND WRITTEN PROBLEMS - HOYT-PEET

In each instance the fact in parenthesis indicates the fact asked for. Read to the left of the figure thus: What are 60 seconds equal to? Frequency of occurrence is shown in the column of cells to the left. Read to the right of the figure thus: How many seconds in 1 minute? Frequency of occurrence is shown in the column of cells to the right. The frequency of occurrence in examples is shown in the upper left of the cell; the frequency of occurrence in written problems is shown in the lower right of each cell. Blank indicates no occurrence.

60 seconds = (1 minute)					1 minute = (60 seconds)
60 minutes = (1 hour)				1	1 hour = (60 minutes)
24 hours = (1 day)			1		1 day = (24 hours)
7 days = (1 week)			3	5	1 week = (7 days)
365 days = (1 year)			1		1 year = (365 days)
366 days =(1 lp. year)			1		1 lp. year = (366 days)
52 weeks = (1 year)			2	3	1 year = (52 weeks)
12 months = (1 year)			1	11	1 year = (12 months)
100 years = (1 century)					1 century = (100 years)

REDUCTION OF DENOMINATE NUMBERS

Reduction of denominate numbers is the process of changing their denomination without changing their value. Denominate numbers may be changed from a higher to a lower denomination, as for example, when 2 miles are reduced to feet; denominate numbers may also be changed from a lower to a higher denomination, as when 21 pints are reduced to gallons. The former process is known as descending reduction; the latter, as ascending reduction.

Meaning and Reading of Tables LXII to LXXIII.

The upper figure shows descending reductions. The unit of measure at the head of the column of vertical squares in these figures read in connection with each of the cells in these columns indicate the denomination from which the reduction is made; when these terms are read in connection with the row of horizontal cells to the left, they indicate the denomination to which the reduction is made.- The lower figures show ascending reductions. The unit of measure read in connection with the horizontal rows of cells to the right indicate the denomination from which the reduction is made; read in

connection with the vertical column of cells it refers to the unit to which the ascending reduction is made. Frequency of occurrence of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell.

TABLE LX. REDUCTIONS IN UNITED STATES MONEY-HOYT-PEET

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of cell; those appearing in written problems in lower right. For further details as to meaning and reading of table see page 89.

	Dollars	Half dollars	Quarters	Dimes	Nickels	Cents
Half dollars	2					
Quarters	3	3				
Dimes	4	1	1			
Nickels	2	2	1	1		
Cents		2 3	6 9	28 11	21 1	
Mills						2

	Cents	Nickels	Dimes	Quarters	Half dollars	Dollars
Half dollars						
Quarters						
Dimes						
Nickels						
Cents		5	5			
Mills	2					

TABLE LXI. REDUCTIONS IN LINEAR MEASURE - HOYT-PEET

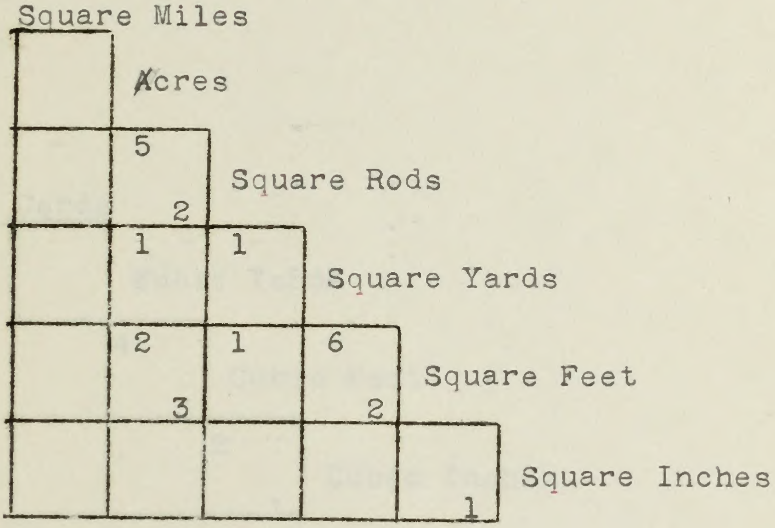
The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; those appearing in written problems are shown in the lower right of each square. For further details as to meaning and reading of tables see page 89.

	Miles	Rods	Yards	Feet
Rods				
Yards	1 1	 2		
Feet	11 5	9 5	46 6	
Inches			49 2	43 2

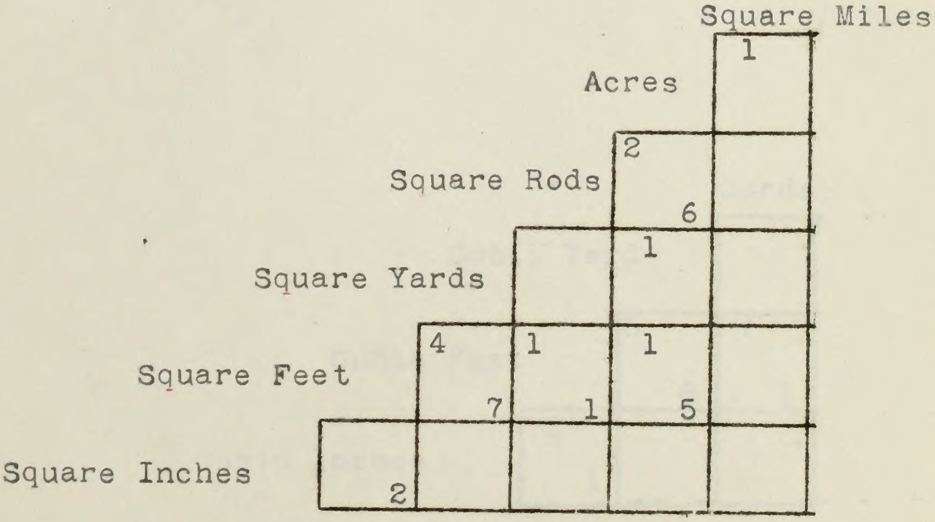
	Feet	Yards	Rods	Miles
Rods				1
Yards			1	
Feet		24 31	4	3 8
Inches	20 10	19 1		

TABLE LXII. REDUCTIONS IN SQUARE MEASURE - HOYT-PEET

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; those appearing in written problems are shown in the lower right of each square. For further details as to meaning and reading of table see page 89.



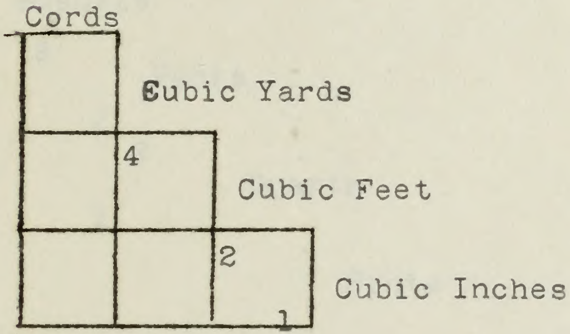
	Square Miles	Acres	Square Rods	Square Yards	Square Feet
Acres					
Square Rods		5 2			
Square Yards		1	1		
Square Feet		2 3	1	6 2	
Square Inches					 1



	Square Feet	Square Yards	Square Rods	Acres	Square Miles
Acres					1
Square Rods				2 6	
Square Yards				1	
Square Feet		4 7	1 1	1 5	
Square Inches	 2				

TABLE LXIII. REDUCTIONS IN CUBIC MEASURE - HOYT-PEET

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell.



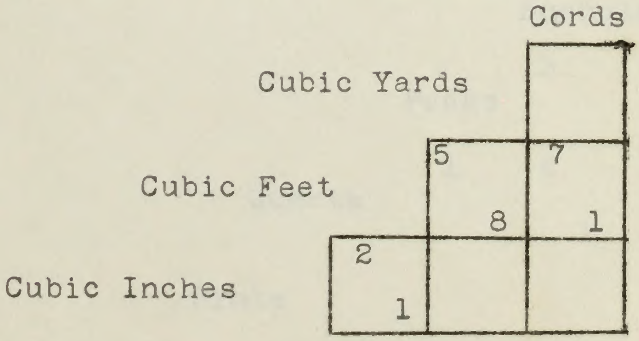
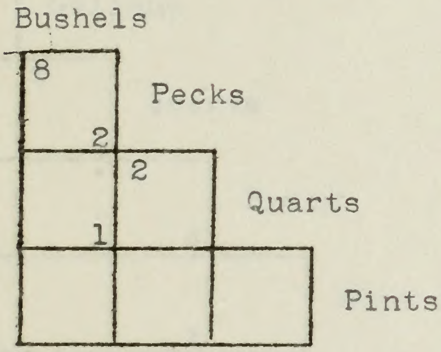


TABLE LXIV. REDUCTIONS IN DRY MEASURE- HOYT-PEET

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; those appearing in written problems are shown in the lower right of each square. For further details as to reading and meaning of table see page 89.



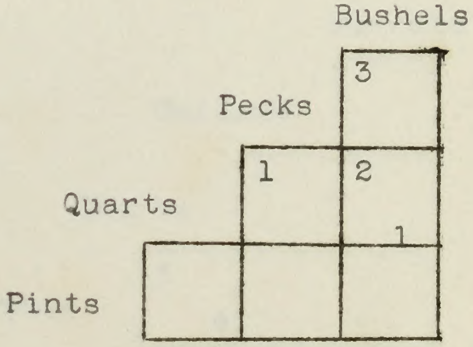
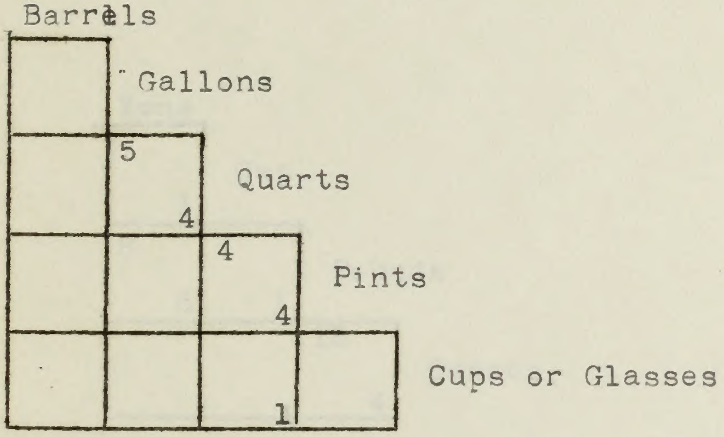


TABLE LXV. REDUCTIONS IN LIQUID MEASURE - HOYT-PEET

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell. For further details as to reading and meaning of table see page 89.


Barrels
Gallons
5
4
Quarts
4
4
Pints
1
Cups or Glasses

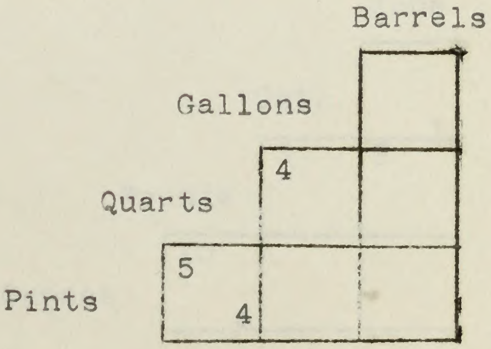

Barrels
Gallons
4
Quarts
5
4
Pints

TABLE LXVI. REDUCTIONS IN WEIGHT MEASURES - HOYT-PEET

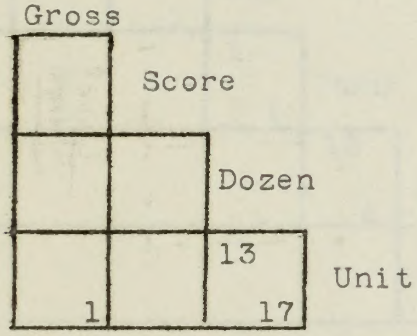
The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each square; those appearing in written problems are shown in the lower right of each square. For further details as to reading and meaning of table see page 89.

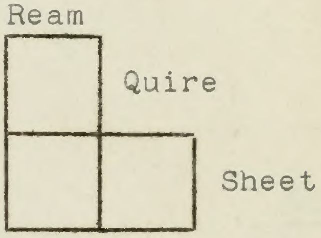
	Tons	Cwt.	Pounds
Cwt.	 1		
Pounds	8 5	1 1	
Ounces			15 4

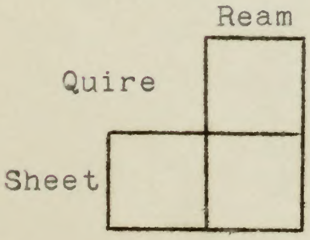
	Pounds	Cwt.	Tons
Cwt.			 1
Pounds		3	3
Ounces	10 6		

TABLE LXVII. REDUCTIONS IN COUNTING - HOYT-PEET

The upper figures show descending reductions; the lower figures descending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell.







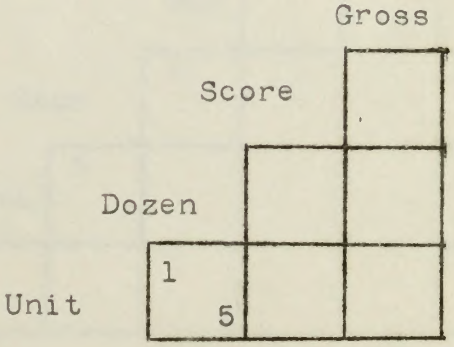
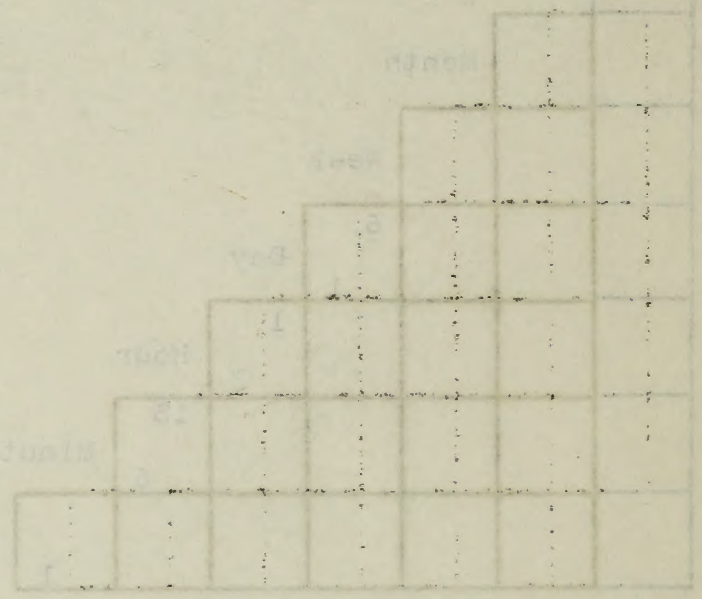


TABLE LXVIII. REDUCTIONS IN TIME - HOYT-PEET

The upper figure shows descending reductions; the lower figure ascending reductions. The frequency of reductions appearing in examples is shown in the upper left of each cell; those appearing in written problems are shown in the lower right of each cell. Further details as to meaning and reading of table may be found on page 89.

	Century	Year	Month	Week	Day	Hour	Minute
Year							
Month							
Week							
Day				6 1			
Hour					1 2		
Minute						13 6	
Second							 1

	Minute	Hour	Day	Week	Month	Year	Century
Year							
Month							
Week					2 1		
Day							
Hour			1				
Minute		3					
Second							



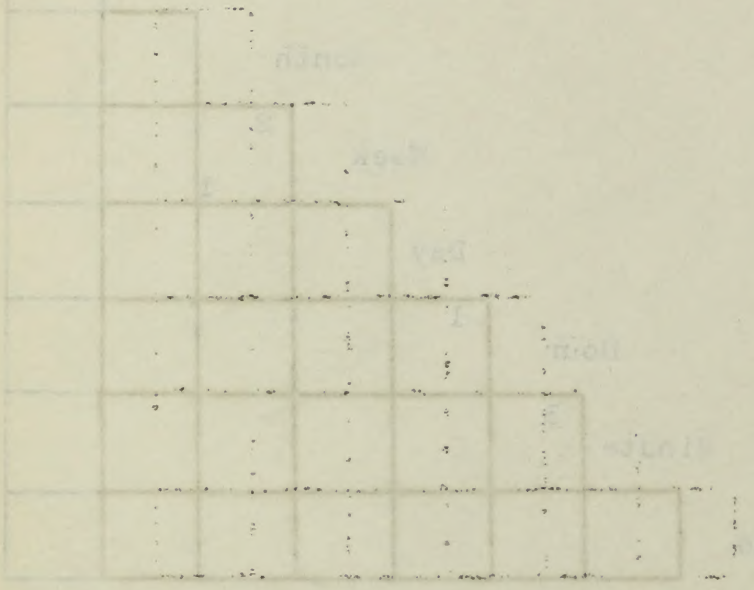


TABLE LXIX. REDUCTIONS IN MEASURES OF CONTENT AND CAPACITY-HOYT-PEET

The upper figure shows reductions from pints and gallons, etc. to cubic feet and cubic inches and the frequency of their occurrence. The lower figure shows the reverse, that is, the changes of cubic feet and cubic inches to pints, gallons, etc. Those occurring in examples are shown in the upper left of the cell; those occurring in written problems in the lower right of each cell.

Gallons	Bushels	Pounds	Tons	
1				Cubic feet
				Cubic Inches

	Gallons	Bushels	Pounds	Tons
Cubic Feet	3	9	4	
Cubic Inches	1			

TABLE LXX REDUCTIONS IN METRIC MEASURES- Hoyt-Peet

Reductions from metric measures to English equivalents and visa versa. The former are shown in fig. 1,2,5 and 6; the latter in fig. 3,4,7 and 8. For further details as to the reading of the table refer to page 89.

Km.	Dm.	m.	dm.	
2 3				Miles
				Yards
	1			Feet
		1	1	Inches

Fig. 1. Length

Ha.	sq.m.	
		Sq. mi.
1		Acres
		Sq. Rods

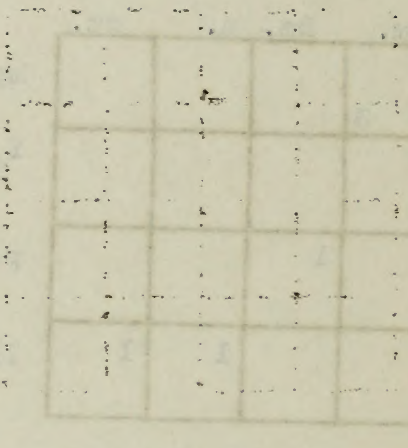
Fig. 2. Square Measure

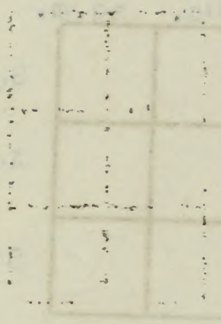
	m	Ha.
Sq. Mi.		
Acres		1
Sq. Rd.	1	

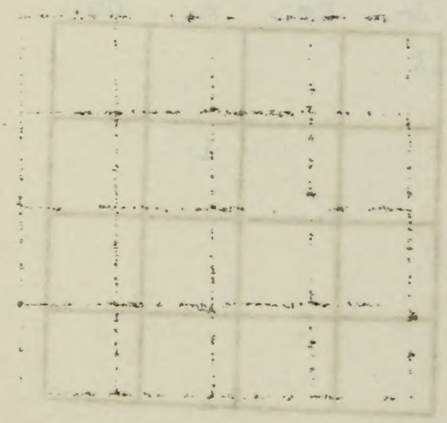
Fig. 3

	Km.	Dm.	m.	dm.
Miles	1			
Yards			1	
Feet				
Inches				

Fig. 4







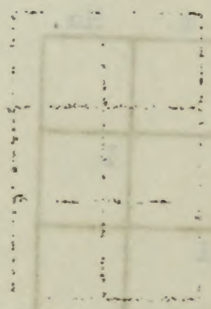


TABLE LXX (Continued)

	Liter	Hl.
Quart		
Gal.	1	
Bushels	1	

Fig. 5

	M.t.	Kg.
Pound		1 1
Ton	1	

Fig. 6

	Mt.	Kg.
Pound		1
Ton	1	

Fig. 7

	Liter	Hl.
Quart		
Gallon	1 1	
Bushel		1

Fig. 8

TABLE LXXI REDUCTIONS IN FOREIGN MONEY- HOYT-PEET

The upper figure shows the number of examples and problems involving changes from United States money to foreign money; the lower figure the number involving changes from foreign money to its equivalent in U.S. money.

United States Money to

2		Pounds (English)
1		Francs
1		Marks
	1	Lira

U.S. Money

Pounds to	6	3
Francs to	2	1
Marks to	1	

COMPUTATION WITH DENOMINATE NUMBERS

Generally speaking, denominate numbers are of two kinds, namely, simple denominate numbers and compound denominate numbers. Simple denominate numbers consist of units of measure of but one denomination, as, 1 inch. Compound denominate numbers consist of two or more units of measure of the same kind, such as, 2 yards 3 feet 5 inches. Lennes calls numbers involving two or more units of different kinds, as for example those expressed in "miles per hour", or "ton-miles" "quasi-denominate" numbers.[1]

Computation in the fundamental processes involving these three types of denominate numbers and the frequency of their occurrence are shown in Tables LXXII to LXXIV.

[1] Lennes, N.J. The Teaching of Arithmetic, p.281.

TABLE LXXII. COMPUTATION WITH SIMPLE DENOMINATE NUMBERS-HOYT-PEET

Unit of measure involved noted on the left; the computation involved noted at head of each column; frequency of occurrence of examples of each noted in upper left; written problem lower right.

	Addition	Subtraction	Multiplication	Division
Inches	9 55	7 27	5 21	21 9
Feet	9 22	6 16	4 12	4 7
Yards	5 43	3 40	3 24	5 3
Rods		 1		2
Miles	 23	 23	1 1	1 3
Square Feet				 1
Square Rods	1	2		
Acres		 1		
Square Miles	 9	 5		
Cubic Inches			1	
Cubic Feet			1	
Bushels	 1		1	

TABLE LXXII (Continued)

	Addition	Subtraction	Multiplication	Division
Pints	1	1		1
Gallons			1	
Barrels			2 1	1
Ounces	1	1	1	1
Pounds	3 14	3 8	4 16	2 1
Hundredweight	1	1	1	
Ton	1 4	2 5	2	
Dozen			1	
Seconds	1	1		
Minutes	1 1	2		1
Hours	1 4	1 1	1 3	1
Days		1 2		
Degrees	1	5	6 +-	
Cu. ft. (gas)		4		

TABLE LXXII (Continued)

Same as previous, but units of time in connection with the clock or the calendar.

	Addition	Subtraction	Involving A.M.-P.M.	
Hour	7	2		
Hour Minutes	1	13	23 19	
Month day		1		
Yr.Mo. Day		2		
Years		4		
Mo.Day Hr. Min.		1		

TABLE LXXIII. COMPUTATION WITH "QUASI-DENOMINATE" NUMBERS-HOYT-PEET

The first column marked "Addition" shows the number of occurrences of computation in adding the denominate numbers involving the units of measure listed to the left of the figure; the second column shows the number of subtraction computations,etc. Examples are shown in upper left of the cell; written problems in lower right.

	Addition	Subtraction	Multiplication	Division
Miles per minute	2	2	6	
Miles per hour	9	11	19	45
Miles per day			2	16
Miles per day,hr,min				1
Nautical mi.per day				1
Miles per gallon				1
Bushels per acre		3	10	2 5
Tons per acre				1

TABLE LXXIV. COMPUTATION WITH COMPOUND DENOMINATE NUMBERS- HOYT-PEET

The first column marked "Addition" shows the number of occurrences of computation in adding the denominate numbers involving the units of measure listed to the left of the figure; the second column shows the number of subtraction computations, etc. Examples are shown in upper left of each cell; written problems in lower right.

	Addition	Subtraction	Multiplication	Division
Feet inches	3	6 3	8	6
Yard inches	4	6	5	3
Yard feet				1
Rods feet	1		2	
Miles Rods		1		2
Hours Minutes		1		
Sq. yd. Sq. ft.			1	
Sq. ft. Sq.in.				1
Bushels pecks			1	

SUMMARY OF THE HOYT-PEET ARITHMETIC SERIES

In Table LXXV we have a summary of the data gathered with reference to the denominate numbers found in the Hoyt-Peet arithmetics. The data has been grouped under five headings. One group of facts has been omitted from this summary, namely, "Informational Matter with Reference to Denominate Numbers". The reader may refer to pages 73-76 for this data.

Reading and Meaning of Table LXXV.

The tables of measures involved in the summary are listed to the left of the figure. Column 1 shows the number of equalities found in each of the tables; column 2 shows the number of units of measure used as mere words, while column 3 shows the number of written problems involved; in column 4 we find the number of table facts asked in examples and written problems and column 5 shows the number of examples and written problems involved; column 6 shows the total number of reductions, while column 7 shows the number of examples and written problems involved in these reductions; column 8 shows the number of units of measure used in computation and column 9 the number of examples and written problems involved in computation with simple denominate numbers; column 10 shows the number of compound denominate numbers used and the final column shows the number of examples and written problems involved in computation with compound denominate numbers.

TABLE LXXV. SUMMARY OF HOYT-PEET ARITHMETICS

FOR reading and meaning of table see page 110.

	1 Equalities	2 Word	3 Examples	4 Table Facts	5 Examples	6 Reductions	7 Examples	8 Computation	9 Examples	10 Compound	11 Examples
U.S. Money				4	59 10	10	91 23				
Linear Measure	4	4	214	5	16 2	16	231 73	5	85 329	5	48 3
Square Measure		2	22			14	18 29	4	3 16	2	2
Cubic Measure	2	1	1	2	2	5	20 11	2	2		
Dry Measure	3	3	39	3	11 16	9	16 4	1	1 1	1	1
Liquid Measure	2	3	31	2	6 1	5	18 13	3	4 4		
Weight Measure	3	3	135	3	6	8	40 23	4	17 52		
Counting	3	2	97	2	3 17	5	18 29	1	1		
Time	6	7	246	7	9 20	7	26 11	4	7 13		
Clock Calendar								6	37 85		
Metric Measures	29										
English Equivalents	8					17	21 6				
Foreign Exchange						7	13 5				
Quasi-Den.No.								8	2 134		
Misc. Measures	15	5	32					2	11 6		

TABLE LXXVA. DETAILED SUMMARY OF REDUCTION- HOYT -Peet.

Column one shows the total number of descending reductions with reference to each table of measure listed to the left of the figure. The second column shows the total number of ascending reductions. Column 3 and 4 show similar data for ascending reductions.

	Desc.Reduct.	Examples	Asc. Reduct.	Examples
United States Money	15	79 23	3	12
Linear Measure	7	159 23	7	72 50
Square Measure	7	16 8	7	12 21
Cubic Measure	2	6 1	3	14 10
Dry Measure	3	10 3	3	6 1
Liquid Measure	3	9 9	2	9 4
Weight Measure	4	24 11	4	16 12
Counting	2	13 18	3	5 11
Time	4	20 10	3	6 1
Engl. Eq. of Metr We.	9	13 5	8	8 1
Foreign Exchange	4	4 1	3	9 4

Final Summary and Concluding Observations

TABLE LXXVI. FINAL SUMMARY

	Strayer-Upton	Hoyt-Peet
Tables		
Number of tables in texts	16	13
Number of relations in tables	68	60
Number of Miscellaneous relations	20	15
Total number of relations taught	88	75
Units of measure merely mentioned	26	30
Table facts in examples and written problems		
Number of table facts	20	28
Number of examples and problems involved	61	168
Reductions		
Number of reductions	109	109
Examples and problems involved	482	639
Computation		
Simple units of measure	23	27
Examples and problems involved	399	673
"Quasi-Denominate" numbers	10	8
Examples and problems involved	136	136
Compound denominate numbers	10	8
Examples and problems involved	73	54

Concluding Observations.

1. One notes the absence of many of the tables of measurement found in older arithmetic text-books but now generally considered obsolete. However, the metric system is still retained in both series, a doubtful procedure. The Upton-Strayer series also retains the tables of so-called "useful equivalents in liquid measure," called in this study "measure of capacity," as well as the table of "useful equivalents in dry measure," called in this study, "measure of content."

2. Each series insists on the memorization of the entire table of measure as such. The Fourth Yearbook of the Department of Superintendence stated that "tables as such are unnecessary."[1] Louth also found in her study that tables of measurement, as such, are seldom used in their entirety. Why then, should a table, as such, be memorized?

3. The Hoyt-Peet Arithmetics retain foreign exchange. It will be recalled that the Fourth Yearbook of the Department of Superintendence recommended that no provision for formal drill be made for work in foreign exchange.

4. The greatest emphasis in each series of texts is placed on reductions. The Fourth Yearbook of the Department of Superintendence asserted that "no reductions, either ascending or descending, occur in business situations except those made by the highly trained exper,"[1] This has been confirmed by the studies of Louth, Sala, and Traniello.

5. There is a modern tendency to eliminate computation with compound denominate numbers entirely. But a large number of examples and problems with compound denominate numbers have still been retained in these texts.

6. Tho much of the work with denominate numbers is done incidentally in connection with other phases of arithmetic, such work must be justified on the basis of its social usefulness.

7. More emphasis needs to be placed on teaching the use and meaning of units of weight through commodities. But to say that "fruits, grains, vegetables are measured by the pint, the quart, the peck, and the bushel" has little value. Each commodity must be joined with the specific unit of measure with which it is used.

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[1] Fourth Yearbook, Department of Superintendence, p.178.

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